Before the
FEDERAL COMMUNICATIONS COMMISSION
Washington, D.C. 20554

In the Matter of	)	
	)	
Establishment of Interference Temperature	)	
Metric to Quantify and Manage Interference and	)	ET Docket No. 03-237
To Expand Available Unlicensed Operation in	)	
Certain Fixed, Mobile and Satellite Frequency Bands	)	

COMMENTS OF

GLOBALSTAR, L.P., ICO GLOBAL COMMUNICATIONS, INMARSAT VENTURES LTD., INTELSAT GLOBAL SERVICES CORP., LOCKHEED MARTIN CORP., LORAL SPACE & COMMUNICATIONS LTD., NEW SKIES SATELLITES, NORTHROP GRUMMAN SPACE TECHNOLOGY, PANAMSAT CORPORATION AND SES AMERICOM, INC.

April 5, 2004

TABLE OF CONTENTS

Before the
FEDERAL COMMUNICATIONS COMMISSION
Washington, D.C. 20554

In the Matter of	)	
	)	
Establishment of Interference Temperature	)	
Metric to Quantify and Manage Interference and	)	ET Docket No. 03-237
To Expand Available Unlicensed Operation in	)	
Certain Fixed, Mobile and Satellite Frequency Bands	)	

COMMENTS OF
GLOBALSTAR, L.P., ICO GLOBAL COMMUNICATIONS, INMARSAT VENTURES LTD., INTELSAT GLOBAL SERVICES CORP., LOCKHEED MARTIN CORP., LORAL SPACE & COMMUNICATIONS LTD., NEW SKIES SATELLITES, NORTHROP GRUMMAN SPACE TECHNOLOGY, PANAMSAT CORPORATION AND SES AMERICOM, INC.

Globalstar, L.P., ICO Global Communications, Inmarsat Ventures Ltd., Intelsat Global Services Corp., Lockheed Martin Corp., Loral Space & Communications Ltd., New Skies Satellites, Northrop Grumman Space Technology, PanAmSat Corporation and SES Americom, Inc. (collectively, the "Satellite Companies") hereby submit comments in response to the *Notice of Inquiry and Notice of Proposed Rulemaking* in the above-captioned proceeding, FCC 03-289 (rel. Nov. 28, 2003) (the "*NOI*" and "*NPRM*" or the "*Notice*").

The Satellite Companies have serious concerns with the interference temperature approach as outlined in the *Notice* and with the proposal to experiment with this approach in bands that are allocated for satellite services. We support the Commission's goal of developing spectrum management policies aimed at enhancing incentives for users to "migrate to more technologically innovative and economically efficient uses of the spectrum." *Notice* at ¶ 6. However, the Satellite Companies question whether the interference temperature approach is feasible and whether it would facilitate achievement of that goal.

In short, the Commission's proposals are premature. There are significant technical and regulatory obstacles to the plan to implement an interference temperature framework in satellite frequencies. Pushing forward with the proposals in the *Notice* before these obstacles are addressed will harm satellite licensees and will thwart, not promote, technical innovation.

I. INTRODUCTION AND SUMMARY

The Satellite Companies include leading U.S. satellite manufacturers, system operators, service providers, and launch service companies. The Satellite Companies are also members of the Satellite Industry Association ("SIA").

SIA has previously expressed its concerns about the interference temperature concept in response to the request for comments by the Spectrum Policy Task Force ("SPTF").[1] In particular, SIA noted that the proliferation of unlicensed devices pursuant to an interference temperature regulatory approach could threaten the viability of existing services and impede technological advances by licensees. *Id.* at 13-14. Furthermore, SIA pointed out that Section 301 of the Communications Act restricts the Commission's ability to authorize unlicensed devices that interfere with licensed operations. *Id.* at 14-16. Numerous other

[1] *See* Comments of the Satellite Industry Association, ET Docket No. 02-135 (filed Jan. 27, 2003) ("SIA SPTF Comments"). The Satellite Companies hereby incorporate these SIA SPTF Comments by reference herein.

commenters raised similar concerns regarding interference temperature in response to the SPTF report.[2]

Unfortunately, the instant *Notice* does little to assuage any of the misgivings about the interference temperature concept that were raised by the parties in the SPTF proceeding. The *NOI* portion of the document seeks comment on many of the technical and legal issues surrounding the interference temperature idea that were identified by parties. However, the Commission also asks whether it would be feasible to proceed with application of the interference temperature approach in selected bands, notwithstanding its recognition that development of the "underlying information, analyses and policy plans" needed for implementation of the interference temperature approach will require "substantial time and effort to complete." *Notice* at ¶ 29.

The clear answer to that question is no. Significant technical and policy issues regarding the interference temperature approach must be resolved before any experimental application of the approach to specific bands takes place, particularly bands that are already in use by licensed facilities. Furthermore, there are specific difficulties associated with the Commission's proposal to use satellite

---

[2] *See, e.g.,* Comments of Hughes Network Systems, Inc. ("HNS") at 3-8; Lockheed Martin Comments at 6-9; Boeing Comments at 7-8; PanAmSat Comments at 4. *See also* Comments of the Telecommunications Industry Association at 8-9; Comments of Comsearch at 3; Comments of AT&T Wireless Services, Inc. at 8-14; Comments of Cingular Wireless LLC ("Cingular") at 17-38; Comments of Arch Wireless Operating Company, Inc. ("Arch Wireless") at 2-4; Comments of Motorola, Inc. at 12-14; Comments of Sprint Corporation at 14-16; Comments of BellSouth Corporation at 8-12; Comments of Wireless Communications Association International, Inc. at 9-12; Comments of Nokia Inc. at 4-5 (all filed Jan. 27, 2003).

spectrum for its initial interference temperature experiment. These problems are identified in greater detail below. Unless the Commission has measures in place that will ensure protection of licensed operations, it cannot go forward with its interference temperature proposals.

Premature implementation of an interference temperature approach will thwart, not promote, the Commission's stated goals. Satellite operators already have strong incentives to use their spectrum as efficiently as possible, and over the years, significant advances have been made. As efficiency has increased, though, so has the susceptibility of systems to interference. Satellite systems cannot continue to deploy new technologies and introduce innovative services if their ability to fully use their licensed spectrum is impaired by the introduction of unlicensed devices.

The *Notice* envisions a "win-win" situation that permits more robust utilization of spectrum by introducing new users without any adverse impact on current licensees. Such an outcome may be possible at some future time in some bands, depending on the existing services to which the bands are allocated. The Satellite Companies support further study to assess the technical feasibility and regulatory implications of the interference temperature concept pursuant to the *NOI*. But too many critical questions regarding the interference temperature approach today remain unanswered. Accordingly, the Satellite Companies strongly oppose the Commission's plan under the *NPRM* to proceed with use of the interference temperature framework in satellite spectrum.

II. A FIXED INTERFERENCE TEMPERATURE IN SATELLITE SPECTRUM WOULD IMPAIR, NOT IMPROVE, EFFICIENCY

The *Notice* suggests that employing an interference temperature approach would result in more efficient use of spectrum. *Notice* at ¶ 1. The *Notice*, however, fails to consider the impact of increasing the noise floor on incumbent operations. In satellite spectrum, setting a fixed interference temperature limit could block licensees' ability to deploy new services and technologies, resulting in a net loss of spectral efficiency.

A. The *Notice* Uses a One-Sided Definition of Spectrum Efficiency

The Notice appears to equate spectral efficiency with an increase in the number of services and users operating in a band. This is an oversimplification that undermines the Commission's analysis of the costs and benefits of an interference temperature approach.

To accurately assess the impact of a new interference model on overall efficiency, the Commission must also evaluate the uses of the spectrum being made by existing operations. Furthermore, the Commission must recognize that no single index can adequately measure spectrum efficiency.

In its recent Notice of Inquiry on spectrum policy for the 21st century, NTIA addressed this issue, noting that:

> Efficiency has been defined in a number of ways, e.g., technical efficiency (bandwidth, frequency reuse, geographical coverage, etc.), economic efficiency (revenue, profit, added value, etc.), and functional efficiency (reliability, quality, ease of use, etc.). Depending on the balance of these types of efficiency metrics, there could be different

> benefits to users, taxpayers, various stakeholders, the economy, and society.[3]

The Commission must similarly consider all aspects of spectrum efficiency in considering the pros and cons of an interference temperature approach.

B. Satellite Systems Use Spectrum Resources Efficiently

Over their relatively brief history, commercial satellite systems have developed and implemented significant technological advances to maximize spectrum efficiency. As a result, today's systems are remarkably efficient, and developments currently on the horizon promise further gains.

These improvements have occurred not because of any regulatory mandates but for the simple reason that every aspect of the construction and operation of satellite systems is extremely capital-intensive. Typical geostationary satellite systems cost hundreds of millions of dollars to build, launch, and insure, and nongeostationary constellations can cost even more. Furthermore, a satellite's useful life is measured in decades, not years, and no changes can be made to a spacecraft's design once it is in orbit. Thus, the enormous sunken costs of a facility must be recovered over a long period by leveraging the system's spectrum resources to the greatest extent possible.

The success of the satellite industry has been driven by these operational improvements, including more efficient satellite and earth station

---

[3] *Notice of Inquiry*, United States Spectrum Policy for the 21st Century, Dkt. No. 040127027-4027-01, 69 Fed. Reg. 4923 at ¶ 10 (Nat'l Telecom. & Info. Admin. 2004).

antennas, higher-order modulation techniques, analog to digital conversion, use of smaller antennas, new coding, and multiple access techniques. All these developments have contributed to increasing the technical, economic, and functional efficiency of satellite systems.

A few specific examples will help to underscore the significant increases that satellite systems have achieved with respect to technical, economic and functional efficiency.

The conversion of TV signals from analog to digital has allowed the transmission of six television channels in a 36-MHz transponder instead of typically one television channel per transponder. This increase in technical efficiency has allowed the distribution of more video channels, resulting in more choices to the end user, *i.e.* an increase in functional efficiency. Substituting digital carriers for analog TV/FM carriers also increases technical efficiency by eliminating a very interfering type of emission that typically precludes about 15% of the spectrum allocated to a TV/FM carrier to be used with the same polarization in the adjacent satellite. A new increase in functional efficiency is being achieved with the transmission of two HDTV channels per 36-MHz transponder, thereby improving service quality to the end user.

Other significant examples of increases in technical efficiency are developments in satellite antenna technology that allow multiple frequency reuse through space isolation (multiple beams); advanced coding and higher-order modulation techniques, such as 8PSK and 16-QAM, permitting significant increases in data rate within the same spectrum resource; and demand assignment techniques that maximize the number of satellite users that can access a given resource. Systems being deployed today also are making increasing use of high-gain spot beams that permit even faster data rates. Finally, one of the key elements for the success of DTH/DBS lies in the technological developments that achieved lower receiver noise temperatures, and thus allowed the use of smaller end user antennas, increasing functional efficiency.

C. A Fixed Interference Temperature Level Would Lock Satellite Licensees Into Current Technology, Blocking Future Advances

The advances described above would not have been possible if satellite system operators had not had flexibility in using their spectrum efficiently. The technological innovations that have made satellite services more robust, commercially attractive and valuable also have made the systems less able to accommodate additional users in the band. Higher-order modulation schemes increase data rates, but are also more susceptible to interference. Along the same lines, smaller earth station antennas, crucial for products that are aimed at residential users, also render satellite links more susceptible to interference.

The simple fact is that we would not have today's broad array of satellite services if the Commission had used an interference temperature approach ten years ago that was tied to the interference sensitivity of satellite links at that time. Similarly, if fixed limits are set reflecting even the most sensitive of today's satellite links, they will necessarily restrict the satellite industry's ability to continue to evolve. In effect, such rules would impose a technology freeze on satellite system operators, handcuffing them to outdated equipment and techniques.

The *Notice* does not even consider these effects on licensed systems, apparently assuming that new users can be introduced into spectrum without any immediate or future adverse effect on incumbent operations. That assumption is clearly wrong. Increasing spectrum users through implementation of a set interference temperature limit will unavoidably constrain the future growth and development of existing users, likely condemning them to eventual obsolescence. The Commission cannot sacrifice the future evolution existing, licensed services in favor of introducing this new concept.

III. ANY INTERFERENCE TEMPERATURE LIMITS MUST ENSURE THAT LICENSED SERVICES WILL BE PROTECTED

The *Notice* requests comment on the level of increased interference that licensed systems should be expected to tolerate under an interference temperature approach. *Notice* at ¶¶ 27-28. This threshold issue is extremely complex, and is not addressed under current rules.

As Commissioner Copps observes in his separate statement:

> While the interference temperature metric may be a good new way to measure interference, we do not have an adequate way to determine what the right interference temperature is for a given band. The only tools we have for this job are the ill-fitting and ill-defined "interference" and "harmful interference" concepts. The inappropriateness and inadequacy of these concepts for the job of

> prospectively setting interference temperature will make this new metric very hard to use predictably and non-arbitrarily in the real world.[4]

A. Harmful Interference Is Not an Acceptable Benchmark

The *Notice* states that "harmful interference is defined by our rules as interference that causes serious detrimental effects as opposed to interference that is merely a nuisance or annoyance that can be overcome by appropriate measures." *Notice* at ¶ 27. The *Notice* goes on to explicitly ask whether the interference temperature limit should be set at a "level that quantifies 'harmful interference' or some other benchmark, or 'safe-harbor' level that would constitute less than harmful interference?" *Id*. at ¶ 28.

Clearly harmful interference cannot be used as a standard for authorizing new users under an interference temperature approach. Harmful interference is an extreme level of interference that "seriously degrades, obstructs or repeatedly disrupts" the operations of a communications system.[5] Harmful interference is rarely seen when properly functioning radio equipment is used in a frequency band by services or systems that operate on a co-primary basis. At the same time, it is clear that just because interference between such services or systems in a band does not rise to the high level of "harmful interference" it cannot be reasonably concluded that the interference is subjectively acceptable or tolerable to the victim service or users.

---

[4] *Notice* at 30 (separate statement of Commissioner Michael J. Copps).

[5] *See, e.g.*, 47 C.F.R. §§ 1.907, 5.5, & 15.3(m) (definitions of "harmful interference" in the Commission's rules).

For these reasons, harmful interference cannot be used as a benchmark to define the conditions for introducing additional spectrum sharing in licensed bands. More specifically, when defining the aggregate level of interference that unlicensed devices can produce to a licensee of the same spectrum, the use of harmful interference as a reference is completely inappropriate. A licensee cannot be expected to accept interference from unlicensed devices that places its operation at the threshold of being seriously degraded, obstructed or repeatedly disrupted.

B. Interference Temperature Limits Cannot Be Based on the Margin Levels of Licensed Systems

The *Notice* also suggests that system margin "can provide an indication of whether a given operation can tolerate additional undesired RF energy from new unlicensed devices or other sources." Specifically, the Commission states that:

> Where a service has a high service margin, we would generally expect that the interference temperature could be set relatively high (*i.e.*, a significant amount above the noise floor). Conversely, where a service has a low service margin, we would expect that the interference temperature would be set low. *Id.*

This observation implies that if a system operates with a high margin, at least some of it is superfluous and can be used up by interference without any penalty. This is simply incorrect. As the Commission recognizes a few paragraphs later in the *Notice*,

> Communication system designers typically incorporate some built-in operational margin that maintains reasonable performance in the face of

> variables such as anticipated interference/noise levels, component degradation over time, temperature-related circuit fluctuations, the impact on signal levels from the weather, and the like. In other words, the system design must include some reasonable margin for acceptable performance in a changing environment. *Id*. at ¶ 27.

This is exactly what happens in satellite systems. Designers set margins to permit their systems to meet customer-required service objectives under a wide range of operating conditions. Customers expect service to be available and reliable when they want it, not only when the skies are clear, their earth station equipment is brand new, and their antennas are perfectly pointed. For example, a satellite system's high margin may be associated with operation in rainy areas, where any reduction in margin will affect availability and/or throughput, and therefore will have a direct impact on the revenues that the licensed operator can obtain, and either the quality of service that the customers can receive or the number of customers that can be served.

Furthermore, it is important to understand that there are costs associated with a system's margin levels. If new interference sources are introduced that cut into an operator's margins, it must choose whether to risk failing to meet customer service requirements or expending resources to increase signal strength and restore the needed margin – which comes at the cost of capacity available to serve the greatest number of customers over a given satellite. In either event, there is clearly a penalty associated with the new interference.

In short, the Commission cannot use satellite system margin levels as a proxy for determining whether such systems can tolerate a substantial increase in interference.

C. Any Unlicensed Operations Must Comply with Section 301

As SIA noted in its comments on the SPTF report, Section 301 of the Communications Act also constrains the Commission's ability to use an interference temperature approach to authorize new unlicensed devices. SIA SPTF Comments at 14-16. Section 301 provides that:

> No person shall use or operate any apparatus for the transmission of energy or communications or signals by radio . . . except under and in accordance with this Act and *with a license* in that behalf granted under the provisions of this Act.[6]

The Commission has exempted low-power devices from this licensing power if the record demonstrates that their operation will result in little or no potential for interference to licensed systems. However, as SIA explained, such devices are subject to the condition that they cease operation if actual interference occurs.[7] The Commission clearly cannot give unlicensed devices the right to cause interference to licensed systems without contravening Section 301.

---

6 47 U.S.C. § 301 (emphasis added).

7 *See* 47 C.F.R. § 15.5(b).

D. Any Interference Temperature Limits Must Reflect the Most Sensitive Links in any Given Band

Any determination regarding interference temperature limits also would have to be band-specific and designed to protect the most sensitive links in the band. Interference effects cannot be evaluated in a vacuum. In each service and frequency band, a wide variety of factors will affect the ultimate impact of any new interference sources. As a result, setting of interference temperature limits would have to be done on a band-by-band basis.

In any individual band, the limit would have to be set to ensure that the most interference-sensitive services are protected. Furthermore, to avoid the technology "freeze" problem discussed above, the limits would have to be subject to review and downward adjustment when new, more sensitive services are introduced.

The Commission must consider each of these factors in any determination regarding interference temperature limits to ensure that the rules do not impose unwarranted and unlawful interference burdens on existing operations.

IV. THERE ARE SIGNIFICANT PRACTICAL OBSTACLES TO IMPLEMENTATION OF THE INTERFERENCE TEMPERATURE APPROACH IN SATELLITE SPECTRUM

Assuming the threshold issues discussed above regarding the definition of interference temperature levels can be resolved, the Commission will also need to address a number of issues relating to the mechanics of employing an interference temperature approach to support the deployment of new services in licensed spectrum. In particular, the *Notice* recognizes that:

> For an interference temperature limit to function effectively on an adaptive or real-time basis, a system would be needed to measure the interference temperature in the band and communicate that information to devices subject to the limit, and a response process would also be needed to restrict the operation of devices so as to maintain the interference temperature at or below the level of the limit. *Notice* at ¶ 11.

The Satellite Companies agree that these are necessary elements of any attempt to rely on interference temperature as a spectrum management tool. However, under existing technology, there are significant barriers to accomplishing these critical functions.

A. Monitoring Interference Temperature and Disseminating Information to Affected Devices Will Be Extremely Difficult and Costly

The *Notice* describes three possible methods for monitoring the interference temperature and communicating the results to devices that are using the spectrum:

1. "The device would measure the interference temperature at its location and make a transmit/not transmit decision based on this measurement plus the device's own contribution of RF energy." *Notice* at ¶ 11.

2. "[T]he receive sites of a licensed service" would "measure the temperature and communicate those measurements to a central site, where the interference temperature profile for the region would be computed" and broadcast to potential unlicensed users. *Id.*

3. "[A] grid of monitoring stations . . . would continuously examine the RF energy levels in specified bands, process that data to derive interference temperatures, and then broadcast that data to subject transmitters on a dedicated frequency . . . . The transmitted temperature data from this monitoring system could also include the frequency and geographic location of the interference temperature measurement(s) and the measurement bandwidth so that an individual device could compute the rise in temperature due to its own contribution and make a decision to transmit." *Id.* at ¶ 12.

Applying any of these proposed methods to satellite spectrum presents substantial practical difficulties.

Method 1 is fundamentally unsuitable for spectrum licensed for satellite uplinks. Under method 1, the device being introduced into the licensed spectrum takes the interference temperature measurements. The assumption is that those measurements will reflect the device's impact on the receiver that will be subject to the effects of the interfering emission. In the case of satellite uplink spectrum, however, that assumption is invalid. The device will be measuring the interference temperature on the ground, but the affected receiver will be thousands of miles away, on the orbiting spacecraft.

Furthermore, the spacecraft will "see" interference not just from any individual device, but from all devices operating in that spectrum within the coverage area of the spacecraft. Obviously, the measurements made by a single device cannot reflect the aggregate impact of these multiple interferers. Under these circumstances, there is no practical way for the unlicensed device to "know" the interference received by the satellite by sampling the immediate interference environment.

Method 2 could eliminate the basic shortcoming in Method 1, but would be prohibitively complex and costly to implement in satellite spectrum. Method 2 contemplates that the equipment to monitor the interference temperature would be placed on the licensed system's receivers. For satellite spectrum, that would require deploying monitoring equipment on the spacecraft itself or at receive earth stations. There are significant issues with either alternative.

Placing monitoring devices on spacecraft does not appear to be a viable option. First, measurement equipment suitable for deployment on a satellite would have to be developed, space qualified, and incorporated into the design of a new spacecraft. Even if that could be achieved, placing the equipment on the satellite would significantly impact the satellite's complexity, weight and throughput. These factors would increase the cost of the construction, launch, operation, and insurance of the satellite as well as affecting the risk of satellite failure. All these costs – which would run in the tens of millions of dollars – would have to be borne by the new services being introduced in the band.

There are also substantial obstacles to placing the measurement equipment at the receive earth station. Many stations are quite small, and monitoring the interference temperature would require equipment that is significantly more complex than the terminal itself. There are millions of satellite receive terminals operating in the U.S., and deployment of the facilities for monitoring and disseminating interference temperature information would be costly and time-consuming. Again, the costs associated with these efforts would need to be funded by the beneficiaries of the system – the new operators being introduced into the spectrum.

The only remaining possibility is to deploy dedicated monitoring stations that would evaluate the aggregate impact from unlicensed devices across the entire satellite band, as contemplated under method 3. However, as the *Notice* acknowledges, "additional time will be needed to develop and implement the monitoring networks, technologies, and devices . . . for detecting and relaying interference temperature information to central control stations that would forward this information to transmitters to control the level of RF emissions." *Notice* at ¶ 29.

For satellite uplink bands, one of the main technical hurdles that would have to be overcome in order to adequately protect satellite links is to appropriately measure the aggregation effect of all unlicensed devices across the entire satellite receive footprint. As noted above, an in-orbit spacecraft can "see" interference over an area of thousands of square miles, which makes developing an appropriate monitoring system a challenging task.

In addition, there are further technical difficulties associated with evaluating the interference impact on different types of satellites. Using ground-based measurement equipment will not provide accurate data concerning uplink interference to spacecraft that use on board signal processing because the noise floor from the uplink is not present on the downlink. In the case of bent-pipe type satellites, the total noise floor can be measured on the ground, and then the uplink portion of the noise floor, *i.e.*, the aggregate (N+I) in the uplink, can be determined. This approach has an inherent difficulty in separating the uplink and downlink components from the total noise floor measurement. Even though a large earth station antenna may be used to minimize the downlink interference effects, it will be difficult to accurately quantify the interference noise temperature level caused by the unlicensed devices in the uplink.

Another implementation issue is that one station (or at the very least one satellite antenna at a common facility) would be required for each satellite. For each spacecraft being monitored, measurements would be needed in each of many sub-bands making up the total satellite band. If 25 MHz segments are assumed, for example, each satellite would typically produce 40 channels of measurement data (20 channels per polarization). These 40 channels of data from each satellite would then have to be sent to a common processing facility that would aggregate the data and distribute it nationally. Obviously, this would require an extremely sophisticated and very costly system.

A third challenge relates to the measurement of emissions generated by unlicensed devices and other sources of interference. For the interference noise floor to be effectively measured requires that the licensed carrier be turned off. However, if the licensed carrier must be turned off, it will be impossible to do real-time measurements. If the bandwidth of the unlicensed device emissions is much larger than the satellite carrier, it would be possible to make a real-time measurement in the band adjacent to the satellite carrier. However, such a measurement will be corrupted by the out-of-band power of the satellite signal.

These issues could be addressed only if the Commission imposed a channelization plan on any unlicensed devices operating in satellite spectrum that would allow satellites to make real-time measurements. But such a channelization plan would also limit the satellite operator's flexibility in carrier placement and in the maximum carrier size, thereby impairing the operator's ability to function with maximum efficiency.

The final practical implementation issue associated with method 3 is that the measurement made at any monitoring station would consist of noise and interference from all sources. Since interference types cannot be distinguished from each other, it would be impossible to determine the portion of the interference attributable to unlicensed devices. This may not be relevant if the aggregate (N+I) is supposed to be within a certain ceiling. However, the Commission proposes to use a $\Delta T/T$ calculation to evaluate the interference effect of new devices in satellite spectrum. *See Notice* at ¶ 33. Making such a calculation will be impossible based on measured data because the impact of the new device cannot be separately measured.

Thus, each of the methods proposed by the Commission for monitoring interference temperature data and communicating the results to new devices, presents significant, and in some cases apparently insurmountable, technical difficulties when applied to satellite spectrum.

B. Enforcement of Interference Temperature Limits Presents Significant Challenges

As the *Notice* recognizes, an essential element of any interference temperature approach is a framework to ensure that new operations do not cause the applicable interference temperature limits to be exceeded. The difficulties discussed above in monitoring interference temperature levels represent a threshold barrier to such enforcement. Unless the levels can be reliably measured, it will be impossible to determine whether they are being exceeded.

However, even if these difficulties can be resolved, there are also other serious issues regarding the enforceability of interference temperature limits. To date, radiocommunication regulations have been typically based on rules defining the power that can be emitted by a transmitter. One of the main advantages of formulating regulations in this fashion is that the power transmitted is easily measurable, permitting straightforward determination of whether a given facility is in compliance with the limits.

By contrast, under an interference temperature standard that relies on a measure of aggregate interference, determination of compliance will be virtually impossible. The *Notice* seeks comment on issues relating to enforceability, but makes no suggestion as to how enforcement could be accomplished. *Notice* at ¶ 23. How will applicable levels be enforced when there are complaints about interference? How will licensed operators be able to make a case that infringements of the levels have taken place? If a licensed system experiences disruptive interference, how will that situation be remedied, especially if there are thousands or millions of active, unlicensed and thus untraceable systems in operation, and each is causing a part of the unacceptable interference? How can they be turned off when there are so many and they are untraceable because they are unlicensed?

These critical questions go to the core of the viability of the interference temperature concept. And they are not simply rhetorical. The satellite industry has direct experience with exactly this type of scenario. Unlicensed radar detectors manufactured and distributed pursuant to Part 15 rules have caused serious interference that has disrupted the operations of licensed VSAT systems. Although the Commission adopted new forward-looking standards for detectors, its action did not address interfering radar detectors already in use.[8] The Commission stated that such detectors would "continue to be subject to the non-interference requirement in Section 15.5 of the rules." *Id*. (footnote omitted). However, the Commission had already conceded that this requirement could not be effectively enforced:

> [I]dentifying each individual source of interference from radar detectors is not practical for a satellite operator because these devices are mobile and therefore interfere intermittently. Further, these interference sources are not under the control of the satellite operator, so in most cases it is not possible for the satellite operator to remedy the interference even if the source could be identified. *Id*. at ¶ 11.

Nothing in the *Notice* suggests that addressing and remedying disruptive interference will be any easier under an interference temperature approach.

Instead, the *Notice* asks whether technology has "progressed to the level that the [interference temperature] limits could be self-enforced by the radio emitters." *Notice* at ¶ 23. Generally, this suggestion is the regulatory equivalent of asking the fox to guard the henhouse, by relying on the interfering device to police itself. In the case where a satellite operates spot beams, it is made impractical

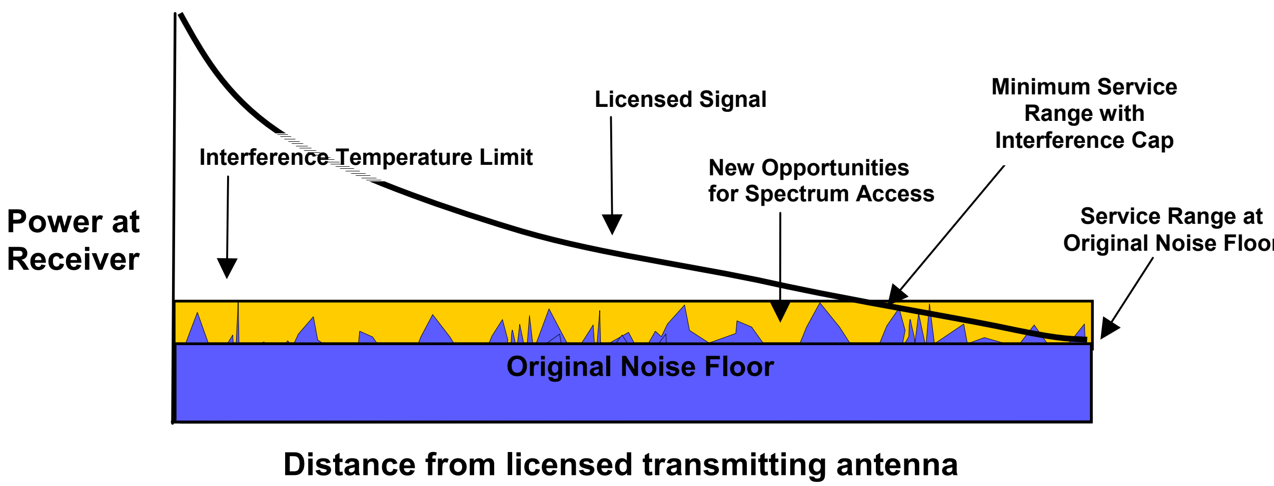
[8] *See Review of Part 15 and Other Parts of the Commission's Rules*, First Report and Order, 17 FCC Rcd 14063 at ¶ 15 (2002).

because of the large numbers of emitters, potentially separated by large distances, that would need to coordinate. A spot beam satellite will be equally sensitive to emitters across a footprint with a diameter of hundreds of miles or more, thus requiring coordination among users well out of direct, or even relayed communications, unless each were to become a satellite terminal. With a single emitter potentially interfering with multiple satellites, each with differing footprints, the permitted density of emitters in a locality would be a complex combination of the potential impacts of different groupings of users – local decisions of each geographic group impacting the decisions of all others in potentially unstable ways. Finally, any technology designed to prevent emissions that would cause the interference temperature to be exceeded will inevitably experience failures. The *Notice* provides no indication concerning how licensees will be able to get relief in the event of such a failure.

Unless strong and effective enforcement mechanisms are developed and adopted, the concept of interference temperature limits is meaningless for use in licensed bands. Implementation of an interference temperature approach under these circumstances would subject licensed operations to unacceptable uncertainty and risk.

In this regard, it is ironic that the *Notice* suggests that existing licensees will benefit from implementation of an interference temperature framework because they will have "greater certainty regarding the maximum permissible interference, and greater protections against harmful interference that could be present in the frequency bands in which they operate." *Notice* at ¶ 1. The Satellite Companies fail to see how the Commission's proposals can be interpreted as beneficial for satellite licensees. Satellite operators could be "certain" only that they would be subject to interference from new spectrum users -- they would not know how many new transmitters would be deployed or where they were located.

To illustrate the benefits of an interference temperature approach, the Commission includes a figure derived from the SPTF report:



This figure graphically demonstrates the negative impact of interference temperature rules on a licensed system. It shows that the licensee's service area would be decreased and its operating margins diminished. The level of interference the licensee would experience either increases or stays the same throughout the service area.

For satellite licensees, the true picture is even worse. The Commission's figure might be an accurate representation of the impact of interference temperature rules on, for example, an AM radio station. Listeners who are relatively close to the station's transmitter will be able to pick up the station even if the noise floor increases – the only impact is on listeners at the far edge of the transmitter's coverage.

Satellites, however, don't have any close-in users. Our signals have to travel thousands of miles to and from an in-orbit spacecraft. If an increase in the noise floor results in a signal not making it all the way to or back from the satellite, the link will fail, disrupting service to the customer. It's an all or nothing proposition. As a result, satellite operations are particularly vulnerable when interference levels increase, and effective enforcement of any interference limits is therefore essential. The *Notice,* however, contains no indication of how such enforcement would be accomplished.

V. THE COMMISSION MUST RESOLVE ALL FUNDAMENTAL ISSUES REGARDING THE INTERFERENCE TEMPERATURE APPROACH BEFORE PURSUING ANY SPECIFIC RULE CHANGES

For the reasons discussed above, the Satellite Companies believe that the interference temperature approach outlined in the *Notice* is not workable in satellite spectrum. Too many fundamental questions regarding the approach remain unanswered today, and many may be unanswerable.

Under these circumstances, it is inconceivable that the Commission would proceed with its proposal to implement the interference temperature in a satellite spectrum band, as discussed in paragraphs 29-51 of the *Notice*. The Commission cannot justify subjecting existing satellite operators to unknown and unknowable risks, jeopardizing services that play a critical role in our nation's telecommunications infrastructure in order to test out a radical departure from existing policies.

Commissioner Adelstein highlighted this point in his concurring statement:

> I think it is very clear that we are exploring an entirely new concept in the interference temperature model, and it is quite premature to actually discuss proposed rules when the Commission has not even engaged in a preliminary discussion on the interference temperature approach as a whole.
>
> I am not sure what the rush is and am not convinced that moving this discussion to the NOI portion of the item somehow holds back our consideration of the interference temperature approach. I think the licensees in these bands deserve better.[9]

The Satellite Companies wholeheartedly agree. The basic merits of the interference temperature concept have not yet been determined. The mechanisms for measurement and enforcement of interference temperature limits, which the Commission acknowledges are essential for the interference temperature approach to work (*Notice* at ¶ 11), have not even been defined, much less implemented. The types of new services that might be authorized pursuant to interference temperature rules have not been identified. Its title notwithstanding, the *NPRM* does not even include any actual proposed rules.

---

[9] *Notice* at 31 (separate statement of Commissioner Jonathan S. Adelstein, approving in part, concurring in part).

The few concrete details to be found in the *NPRM* only make it more clear that the proposals are unwarranted. For example, the Commission asks whether new entrants in the band should be permitted to impose interference up to a level of 5% ΔT/T. This level is comparable to the degree of interference generated by one of the two adjacent satellite networks (nominally 6%) – co-primary systems in the same service. The effect of this new source of interference on the performance of existing satellite links would be substantial. The example link budget in Appendix B of the *NPRM* shows that the 5% allowance applies to the total link and actually corresponds to an even higher uplink ΔT/T. This level of increased interference is clearly unacceptable.

The comments in the previous paragraph should not be understood as implying that a lower ΔT/T value would be acceptable. To the contrary, using any ΔT/T value for new users as the basis for establishing an "interference temperature" approach would violate the underlying principle of the interference temperature concept, *i.e.* use of "white space" or "unused spectrum resources." In the case of a satellite system, the ΔT/T value represents expected performance degradation due to other known users of the same spectrum, and it forms the basis for the coordination agreements that satellite operators enter into with other systems. It does not represent an unused spectrum "commodity" that simply can be consumed by a new class of users. To the contrary, satellite licensees design and implement satellite systems based on the interference environment that they reasonably expect to encounter in view of the conditions of the license. Using a new ΔT/T allocation to form the basis for an "interference temperature" that is associated with the use proposed in the *Notice*, no matter how small that parameter may be, will unquestionably lead to an increase in the noise floor of a satellite system that could not have been reasonably expected and accounted for by the licensee, and will constrain the deployment of more advanced satellite technologies in the future.

A further complication will occur for satellites with receive coverage extending over several countries. If each country were entitled to produce additional interference representing a 5% $\Delta T/T$, the aggregate effect will be much worse. If, on the other hand, the 5% is to be shared among all countries covered by the satellite, it will be impossible to monitor and enforce the overall limit.

In addition, the analysis set forth in Appendix B to the *Notice* is flawed in several specific respects:

a. While the values of Gamma, T and G_{RX} used by the Commission for the extended C band are generally conservative, there are systems under development that are more sensitive still and which should have been protected in the analysis. For example, Intelsat 8 at 304.5 E has beams that are more sensitive (G=34.9 dBi, Gamma=5.3 dB and T=2509 K).

b. It is unclear why the Commission elected to have the GSO beam in the C-band only covering 75% of CONUS. Satellite beams in this band can be designed to cover larger geographical areas than that considered. The analysis should have assumed that interference from unlicensed devices could be received from not only CONUS, but from neighboring countries.

c. The values used by the Commission for the Ku-band are conservative as compared to the system information available through the ITU, but this is a result of the current regulatory environment that has limited fixed satellite service deployments in this band. Internationally, this frequency band is "planned," *i.e.*, each country is provided the allotted frequencies at certain orbit locations.[10] The technical parameters of these systems are defined in the Radio Regulations and have not been updated since 1988. Fifteen years later, it is not surprising that many of the technical parameters are out-of-date. Studies on possible improvements to the regulatory situation and technical parameters in the band are currently under way in the ITU pursuant to WRC-07 Agenda Item 1.10. To adequately protect future FSS deployments in this band, sensitive links with characteristics similar to those in the 14.0-14.5 GHz band should have been used as examples of potential FSS deployments.

The more serious problem, however, is the underlying premise of the *NPRM* itself – the assumption that the interference temperature approach is in the public interest and ready to be applied. The Commission cannot make the fixed satellite and terrestrial fixed service industries that collectively contribute billions of dollars to the U.S. economy guinea pigs in a dangerous experiment. The Commission must dismiss the *NPRM* without further action.

VI. CONCLUSION

For the foregoing reasons, the Satellite Companies question whether the Commission's interference temperature approach is workable at all in satellite spectrum, given the substantial unresolved questions that exist regarding the definition, monitoring, and enforcement of interference temperature limits. What is abundantly clear, however, is that the Commission cannot go forward now with its plan to apply the interference temperature concept to specific satellite bands.

---

10 There are also provisions in the Radio Regulations for administrations to pursue additional orbit locations.

Respectfully submitted,

GLOBALSTAR, L.P. By: <u>*/s/ William F. Adler*</u> Vice President, Legal and Regulatory Affairs Globalstar, L.P. 3200 Zanker Road San Jose, CA 95134	ICO GLOBAL COMMUNICATIONS By: <u>*/s/ Suzanne Hutchings*</u> Senior Regulatory Counsel ICO Global Communications 2000 Pennsylvania Ave., N.W. Suite 4400 Washington, DC 20006
INMARSAT VENTURES LIMITED By: <u>*/s/ Alan Auckenthaler*</u> Vice President Inmarsat Ventures Limited 1050 Connecticut Ave., N.W. Suite 100 Washington, DC 20036	INTELSAT GLOBAL SERVICES CO. By: <u>*/s/ Milenko Stojkovic*</u> Director, Telecommunications Policy & Regulatory Affairs Intelsat Global Services Corporation 3400 International Drive, N.W. Washington, DC 20008
LOCKHEED MARTIN CORPORATION By: <u>*/s/ Gerald Musarra*</u> Vice President, Trade & Regulatory Affairs Lockheed Martin Corporation 1725 Jefferson Davis Hwy, Suite 403 Arlington, VA 22202	LORAL SPACE & COMMUNICATIONS LTD. By: <u>*/s/ John P. Stern*</u> Deputy General Counsel Loral Space & Communications Ltd 1755 Jefferson Davis Hwy, Suite 1007 Arlington, VA 22202
NEW SKIES SATELLITES By: <u>*/s/ Andrew R. D'Uve*</u> Vice President and Associate General Counsel New Skies Satellites Rooseveltplantsoen 4 2517 KR, The Hague The Netherlands	NORTHROP GRUMMAN SPACE TECHNOLOGY By: <u>*/s/ Peter Hadinger*</u> Director, Communications Initiatives Northrop Grumman Space Technology 1000 Wilson Blvd. Suite 2300 Arlington, VA 22209

PANAMSAT CORPORATION By: <u>*/s/ Kalpak S. Gude*</u> Vice President, Gov't & Regulatory Affairs and Associate General Counsel PanAmSat Corporation 1801 K Street, N.W., Suite 440 Washington, DC 20006	SES AMERICOM, INC. By: <u>*/s/ Nancy J. Eskenazi*</u> Vice President & Assoc. Gen'l Counsel SES AMERICOM, Inc. 4 Research Way Princeton, NJ 08540

April 5, 2004